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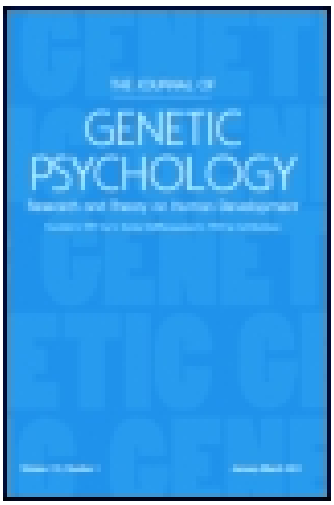

The Pedagogical Seminary and Journal of Genetic Psychology
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/vzpg20

The Role of Dominance in the Social and Sexual Behavior of Infra-Human Primates : IV. The Determination of Hierarchy in Pairs and in a Group

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Published online: 11 Sep 2012.

To cite this article: A. H. Maslow (1936) The Role of Dominance in the Social and Sexual Behavior of Infra-Human Primates : IV. The Determination of Hierarchy in Pairs and in a Group, The Pedagogical Seminary and Journal of Genetic Psychology, 49:1, 161-198, DOI: 10.1080/08856559.1936.10533757

To link to this article: http://dx.doi.org/10.1080/08856559.1936.10533757

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THE RÔLE OF DOMINANCE IN THE SOCIAL AND SEXUAL BEHAVIOR OF INFRA-HUMAN PRIMATES: IV. THE DETERMINATION OF HIERARCHY IN PAIRS AND IN A GROUP*[1]

From the University of Wisconsin Primate Laboratory

A. H. MASLOW

I. INTRODUCTION

The purpose of this paper is fourfold: (1) to check previous experiments reported in this series of papers (1, 5) using better controls, (2) to determine a hierarchy of dominance by interpairing all the animals of a group, (3) to compare the behavior of these paired animals with the behavior of the same animals in larger groups, and (4) to make a preliminary exploration-study of the effect of starvation on dominance behavior.

II. ANIMALS, TECHNIQUE, APPARATUS, PROCEDURE

1. *Animals.* Six rhesus macaques were used in this experiment, of which one died after the second series of interpairings. Weight, size, and sex of the animals are given in Table 1. These animals are as closely matched as is usually possible when they are obtained from a dealer. They are all of the same species and approximately of the same weight[2] and age. It was impossible to get six animals of the same sex, although this had been desired. A few of the pertinent facts about each animal will now be summarized.

The importance of such an individual consideration will be pointed out below. They will be discussed in the order of their dominance in the pairings, the most dominant animal being described first, and so on.

*Accepted for publication by Carl Murchison of the Editorial Board and received in the Editorial Office, December 20, 1935.

[1]I wish here to express my thanks to Miss Kathryn Steiner and Miss Naomi Bernstein for their help in handling the animals, feeding them, etc., during the first half of the experiment.

[2]It will be demonstrated below that closer similarity in weight would have been desirable.

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a. Blue. Male. The biggest and heaviest animal of the six. Paired twice before he died and completely dominant in both pairings.

b. Whitey. Male. Subordinate to Blue, not certainly dominant over Naomi, and certainly dominant over Christy, Red, and Kathryn, although not very positively. Relatively lacking in dominance expression, generally dominance was given to him rather than being asserted by him. Relatively afraid of and disturbed by the experimental situation. Very quiet animal and did not resent overmuch (in his behavior), attempts by his subordinate partners to behave in a dominant fashion. Not very strongly driven by hunger except in spurts. Not strongly driven to sex behavior even when completely dominant (as in pairing with Kathryn). Completely and abjectly subordinate to Blue in their pairing. The general impression is of an animal with a not very strong dominance drive, who is quite ready to take up subordinate rôle at any time, but who is given dominance status because his superior size makes his partners even more subordinate in their behavior.

c. Naomi. A female who reached puberty during the course of the experiments. Unfortunately the services of an endocrinologist were not available and we have, therefore, no concomitant data on her sexual cycle. While we attempted to determine when she was in heat by the state of her sexual skin, breasts, etc., we were not expert enough to do this in any trustworthy fashion. Her heat periods must then be treated as an attenuating factor in our correlations. There is no doubt that she behaved differently at different times (behaving like the typical female in heat) but we were not able to demarcate these periods at all clearly. Her drive to dominance seemed fairly strong. In the pairing with Whitey her urge to dominance was obvious. She was ready to take up this status at any and all times. Since Whitey was not a "dominance-expressive" animal, she was able to do this often. Her appetite for food seemed to fluctuate considerably. It will be noticed that she presented frequently in the pairing with Red even though she was completely dominant. She seemed to be in heat during the first five or six periods, and most of these presentations came at this time.

d. Red. Male. Dominant over Christy and Kathryn, subordinate to Blue, Whitey, and Naomi. An average animal, com-

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TABLE 1*

ANIMALS: NAMES, SEX, WEIGHT, AND CLASSIFICATION

Names	Sex	Weight 3/17/35	Species
1. Blue	Male	8′ 15″	Macacus rhesus
2. Whitey	Male	8′ 10″	" "
3. Naomi	Female	6′ 10″	" "
4. Red	Male	6′ 11″	" "
5. Christy	Male	6′ 5″	" "
6. Kathryn	Female	5′ 4″	" "

*Animals are arranged in descending order of dominance. Blue was most dominant; Kathryn was least dominant.

pletely dominant when dominant and completely subordinate when dominated. When paired with overlord low in dominance expressiveness (Whitey), typically showed dominance behavior whenever this was made possible by Whitey's tolerance.

e. Christy. Male. Dominant over Kathryn, and subordinate to all the others. Dominance over Kathryn only fairly complete. Never completely subordinated; showed *some* dominance behavior in all of his pairings, even when in subordinate status.

f. Kathryn. A female, the youngest and smallest of the six animals. Very strong drive to dominance, although, because of size, had to occupy subordinate status in all her pairings. May be expressed by saying that she seemed to expect subordinate status and accepted it as a matter of course, but never let it hold her down completely. *Very* active animal, most active animal of the six. Very playful and very hard to suppress in her boisterousness. Also seemed to be hungrier than other animals.

2. *Housing and Care.* The housing and care of these animals differ in no essential respect from those described in the second paper in this series (2). Reference should be made to that paper for details. The animals were isolated in their individual living cages at all times except during experimental observations.

3. *Apparatus and Procedure.* The apparatus used in this experiment was practically the same as that used in the previous experiment. The animals, as before, were tamed prior to the beginning of the experiment so that they could be led on a chain from their living cages to the experimental chamber without emotional upset. In this chamber, they were introduced to their partners, and it was in this experimental chamber that *all* social contacts took

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place. Observations were made from behind a one-way screen. The dimensions of this cage were 36 in. x 36 in. x 40 in. It was set on a linoleum flooring which was covered with shavings, one or two inches deep.

In the previous experiment, it had been found that most of the dominance behavior in an experimental period occurred at the beginning of this period. In the present experiment, therefore, the length of this period was halved from 20 minutes to 10 minutes. Accordingly 10 bits of food were used in the food test instead of the previous 20. The first set of three interpairings was continued for 30 experimental periods of 10 minutes each, with three additional periods of observation with the animals under starvation conditions. After this first set of interpairings, the pairs of animals were tested for only 10 experimental periods, since by this time they had become more accustomed to the experimental routine. The correlations in the first set of three interpairings were somewhat attenuated by the differential fear reactions of the animals to the experimental routine. These differential reactions were apparently independent of dominance. Food was not introduced into the experimental situation until the sixth period. In this way we were able again to test the effect of food or struggle for food on the establishment and maintenance of dominance.

The scoring sheets were slightly different from those used in the previous experiment. The following items which had been scored in the previous experiment were not scored in the present one because they had been found impossible to observe accurately, or because they were not connected with dominance; genital inspection, erection, anger, and quiet sitting. The new behavior category of "resistance to aggression" was introduced into the new scoring sheet but turned out not to be very useful.

The pairings were as follows, in chronological order:

First set—Blue and Red, Naomi and Kathryn, Whitey and Christy
Second set—Blue and Whitey, Christy and Kathryn, Naomi and Red
Third set—Whitey and Red, Naomi and Christy
Fourth set—Whitey and Naomi, Red and Kathryn
Fifth set—Red and Christy, Whitey and Kathryn

Blue died after the second set of pairings, leaving five animals for

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interpairings. It will be seen that every animal was paired with every other animal of the group, and it is possible to construct a hierarchy of dominance on the basis of these results.

After all the interpairings had been completed, the behavior of these same animals in larger groups was studied in the following way. A large outdoor cage, equipped with shelves and an indoor compartment, was used. The animals were transferred one by one to this outdoor cage in inverse order of dominance. On the first day, the two least dominant animals were brought in together (C and K). On the next day, the next highest animal in the dominance hierarchy was brought in and allowed to stay there, and so on until all the animals had been put into the outdoor cage. They were allowed to stay in this cage all the time. No attempt was made to isolate them in between observation periods. These observations were made at various times during the day as often as the writer's other duties permitted. He always fed them himself, and was particularly concerned with the changes in group behavior wrought by the introduction of food. He was also primarily interested in observing all behavior that could not have been predicted from the data already obtained in the interpairings, e.g., different hierarchy of dominance, reversals of dominance, alliance groups, etc.

III. Results

The results for the 12 pairings are presented in Tables 2-13. The raw data are given rather than the mere ratios as in the previous experiment (5). The two sets of tables will thus supplement each other to some extent. The name of the behavior categories for which scores were taken will be found at the left side of the tables, the number of the experimental period will be found at the top. Two sets of scores are given after each behavior category, one for each animal. The score for the dominant animal is always given first. For instance, in Table 2 for the Blue-Red pairing, in the fifteenth period, Blue got seven of the 10 pieces of food, Red got three, Blue bullied Red once and Red responded by flight. For the first ten behavior categories, the scores represent merely the number of times the behavior in question occurred. For grooming and play, the first number of the pair represents the number of times the behavior occurred, the second number represents the total number of seconds taken up with this behavior. In the last category (activity),

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TABLE 2
RAW DATA FOR PAIRING OF BLUE AND RED—BLUE DOMINANT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Feeding:	B						7	9	10	9	10	10	10	10	10	7	10
	R						3	1		1						3	
Presentation:	B																
	R	2															1
D. V.:	B	8	3			1											2
	R																
Attempt:	B																
	R																
Bullying:	B											1	1			1	
	R																
Cringing:	B																
	R																
Passivity:	B																
	R	8	3			1							1				2
Flight:	B																
	R											1	1			1	
Resistance:	B																
	R																
Fighting:	B																
	R																
Grooming:	B			2–50	3–90	1–270			1–5		1–15						
	R	5–200	3–365		1–90	1–15											
Play:	B																
	R																
Activity:	B	90	15	20	70	55	30	385	405	265	410	385	335	460	360	475	490
	R	120			15	40		385	255	300	480	460	320	370	255	345	335

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TABLE 2 (*continued*)
RAW DATA FOR PAIRING OF BLUE AND RED—BLUE DOMINANT

		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Feeding:	B	10	9	8	9	10	9	10	9	9	10	10	8	10	10	10	8	8
	R		1	2	1		1		1	1			2				2	2
Presentation:	B																	
	R								1									
D. V.:	B						3	13	10				2	1		3		
	R							2										
Attempt:	B										1							
	R							4	1						1	1		
Bullying:	B		1	1	3	5	5	6	6	2	1	1		2		1	1	3
	R																	
Cringing:	B																	
	R																	
Passivity:	B							1										
	R		1		3	5	4	14	11			1	2	1		3		2
Flight:	B																	
	R		1	1	1		2	4	3	2	1	2				1		1
Resistance:	B																	
	R							1										
Fighting:	B																	
	R																	
Grooming:	B	1–40	1–20					1–10					1–10	1–10				
	R																	
Play:	B																	
	R																	
Activity:	B	255	180	255	325	255	65	15	15	85	90	70	90	60	115	160	185	445
	R	245	180	245	270	280	215		230	260	155	155	155	145	260	195	70	230

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TABLE 3

RAW DATA FOR PAIRING OF NAOMI AND KATHRYN—NAOMI DOMINANT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Feeding:	N						6	2	5	6	6	7	10	10	2	1	3
	K						4	8	5	4	4	3			8	9	7
Presentation:	N																
	K										1			4		2	1
D.V.:	N						2			4	1		7	5	2	1	
	K																
Attempt:	N											1		1			
	K																
Bullying:	N															1	2
	K																
Cringing:	N																
	K																
Passivity:	N										2					2	2
	K						2			4	1		7	5	2	1	
Flight:	N																
	K																
Resistance:	N																
	K																
Fighting:	N																
	K																
Grooming:	N	1–10			2–45	2–25		1–20		4–185	2–55	2–70	1–10	1–10	1–15	1–5	1–15
	K	2–45	3–50		1–20	3–50	3–80	1–15	4–55	7–205	5–145	4–170	7–90	2–40	2–15	1–5	4–440
Play:	N																
	K							1–5	1–5		4–65	1–5	3–20	17–185	4–150	6–135	7–70
Activity:	N	35	65	30	40	60	75	200	225		45	45	20	15	110	50	15
	K	125	165	80	120	185	155	305	295		140	140	275	110	65	115	

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TABLE 3 (*continued*)
RAW DATA FOR PAIRING OF NAOMI AND KATHRYN—NAOMI DOMINANT

		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Feeding:	N	3	2	4	3		7	4	7	4	9	10	8	8	10	8	9	9
	K	7	8	6	7	10	3	6	3	6	1		2	2		2	1	1
Presentation:	N																	
	K			1	1						1	1	1	1		1		
D.V.:	N				1						2							2
	K																	
Attempt:	N										3							
	K																	
Bullying:	N	1	1	1	5		2	3	5	1	4	5	6	8	14	13	7	5
	K																	
Cringing:	N																	
	K																	
Passivity:	N	2																
	K				1				1		3					3		2
Flight:	N																	
	K						2	1	5	3		3	1	2		2	4	
Resistance:	N																	
	K											1				1		1
Fighting:	N																1	
	K																	
Grooming:	N			2–190						1–15	1–5	1–5	5–65	4–45	4–40	3–45	3–50	4–40
	K	5–300	8–500	5–500	14–320	8–230	7–70	2–25	3–20	1–15	6–140				1–15	2–20		2–125
Play:	N													1–10				
	K	8–140	9–70	3–30	12–100	10–75	13–95	7–90	8–50	8–70	13–185	6–55	18–170	11–120	15–125	9–60	7–50	6–45
Activity:	N	15			20		105	190	10			335	30	50	105	10	55	65
	K	140	20	10	65	215	340	480	485	390	85	525	75	210	180	510	330	275

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TABLE 4
RAW DATA FOR PAIRING OF WHITEY AND CHRISTY—WHITEY DOMINANT

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Feeding:	W						7	10		3	3	8	7	8	7	3	4
	C						3		10	7	7	2	3	2	3	7	6
Presentation:	W																
	C	1										1				1	
D. V.:	W	1													4	1	
	C				1		1	1									
Attempt:	W											4			1		
	C																
Bullying:	W																
	C																
Cringing:	W																
	C	2															
Passivity:	W				1		1	1									
	C													1	4	1	
Flight:	W																
	C																
Resistance:	W																
	C											1			1		
Fighting:	W											1					
	C																
Grooming:	W		1–15														
	C	1–295	4–90	2–75	2–65	3–455	4–270	5–280	7–275	6–305	7–345	6–110	7–325	8–375	4–245	3–170	4–165
Play:	W																
	C																
Activity:	W	30			15		130	90				15		70	25	60	15
	C	30		15	60	15	170	160	20					30	25	60	45

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TABLE 4 (*continued*)
RAW DATA FOR PAIRING OF WHITEY AND CHRISTY—WHITEY DOMINANT

		17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
Feeding:	W	5	9	7	4	8	8	8	10	9	8	7	9	10	10	7	10	10
	C	5	1	3	6	2	2	2		1	2	3	1			3		
Presentation:	W		1															
	C		1		1	1	3	1			1	5			1	2		
D. V.:	W	2			3	2	2	2	1		2	6	1					
	C				1		1		3	3	2	2	4		2			
Attempt:	W		1			1		2	2	3	1	1	1					
	C												1					
Bullying:	W										1							
	C																	
Cringing:	W																	
	C																	
Passivity:	W				1		1		3	3	2	2	4		2			
	C	2			3	4	2	3	2	1	2	7	1					
Flight:	W																	
	C					1				2	1					1		
Resistance:	W																	
	C																	
Fighting:	W																	
	C																	
Grooming:	W													3–95	4–40	2–40	1–5	1–25
	C	5–290	6–315	6–410	9–330	8–410	8–175	4–420	6–380	7–320	10–425	9–285	6–285	4–145	5–215	4–195	2–100	5–170
Play:	W																	
	C																	
Activity:	W		55	75	70	15	95	40	105	75		50	120	60	25	55	35	60
	C	5	65	100	70	35	165	10	90	45		50	120	60	25	55	35	80

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TABLE 5

RAW DATA FOR PAIRING OF BLUE AND WHITEY—BLUE DOMINANT

		1	2	3	4	5	6	7	8	9	10	11
Feeding:	B						10	10	10	10	10	10
	W											
Presentation:	B											
	W		1	1								
D. V.:	B	7	4	4	2	3	4	3	7		2	5
	W											
Attempt:	B	7	5		1			1				
	W		1									
Bullying:	B	7	2	7	3	9	5	10	12	1	13	12
	W											
Cringing:	B											
	W	3	3	2		6	6	8	6	1	6	3
Passivity:	B											
	W	4	1	2	3	1	7	2	7		2	5
Flight:	B											
	W	10	5	10	3	6	7	11	8	1	9	4
Resistance:	B											
	W	1		1		1	3				3	5
Fighting:	B	1		2								
	W											
Grooming:	B		3–155	2–20	2–20				3–25		1–5	
	W											
Play:	B											
	W											
Activity:	B	105	250	190	225	235	55	75	90	310	150	120
	W			65	95	80		10		220	20	

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TABLE 6

RAW DATA FOR PAIRING OF CHRISTY AND KATHRYN—CHRISTY DOMINANT

		1	2	3	4	5	6	7	8	9	10	11
Feeding:	C						7	8	10	10	10	7
	K						3	2				3
Presentation:	C	1		1	1							
	K	1		3	1	5	2	1	3	4	1	1
D. V.:	C		1	1		3	3			1		
	K											
Attempt:	C											
	K											
Bullying:	C	2				4	4	2	4	6	5	3
	K							1				
Cringing:	C											
	K											
Passivity:	C											
	K		1	1		5	3	2	1		3	5
Flight:	C											
	K	3					4	2	1	10	5	2
Resistance:	C											
	K	2					3					
Fighting:	C	2		1			1	1	1			
	K					1						
Grooming:	C	1–240	3–145	7–140	6–230	7–145	4–40	5-100	2–20	3–20	2–25	4–95
	K		4–320	2–70	2–15	1–5		1–20			2–15	
Play:	C											
	K		4–40	2–10						3–20		1–5
Activity:	C	160	10	30	85	90	95	30	130	45	55	70
	K	220	90	315	135	270	470	345	455	350	325	465

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TABLE 7

RAW DATA FOR PAIRING OF RED AND NAOMI—NAOMI DOMINANT

		1	2	3	4	5	6	7	8	9	10	11
Feeding:	N						5	10	10	9	10	10
	R						5			1		
Presentation:	N	5	6				1			1		
	R											
D. V.:	N	1		2		1		4			6	1
	R	1										
Attempt:	N			3	2	2		1	1	1	1	
	R											
Bullying:	N	2	4	6	1	2		7	3	2	5	1
	R											
Cringing:	N											
	R									2	6	
Passivity:	N											
	R		1	5		1		6	1			2
Flight:	N											
	R	3	7	5	3	4		5	2	2	9	2
Resistance:	N											
	R	1		3				1	2		1	
Fighting:	N	1		6		3		2	3	1		1
	R											
Grooming:	N			1–10		2–15					1–5	
	R											
Play:	N											
	R											
Activity:	N	165	250	210	55	175	65	120	190	380	280	545
	R	150	100	150	90	10	20	80	175	130	180	420

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TABLE 8

RAW DATA FOR PAIRING OF WHITEY AND RED—WHITEY DOMINANT

		1	2	3	4	5	6	7	8	9	10
Feeding:	W						8	7	8	8	2
	R						2	3	2	2	8
Presentation:	W										
	R	4	2		1	1	1	1			
D. V.:	W	9	1	1	9	3		2	1	1	2
	R	3	1								
Attempt:	W	1					1	1		1	
	R		3								
Bullying:	W				1					1	
	R										
Cringing:	W										
	R										
Passivity:	W	2	1								
	R	10	1	1	8	2		2	1	1	2
Flight:	W										
	R				1					2	
Resistance:	W										
	R										
Fighting:	W										
	R										
Grooming:	W	5	2	1		1			1		
	R	3	2								1–10
Play:	W										
	R										
Activity:	W	135	335	195	360	245	230	420	240	60	165
	R	175	490	345	480	420	215	485	380	325	325

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TABLE 9
RAW DATA FOR PAIRING OF NAOMI AND CHRISTY—NAOMI DOMINANT

		1	2	3	4	5	6	7	8	9	10
Feeding:	N						10	10	9	10	10
	C								1		
Presentation:	N	2	1								
	C					1		1			
D. V.:	N	1	2	3	2	5	1	2	2	5	
	C										
Attempt:	N			1		3					
	C	1									
Bullying:	N	1	2	6	2	5	5	4	5	13	11
	C										
Cringing:	N										
	C			1	3	5	2	3	3	7	2
Passivity:	N										
	C	2		4	1	2			2	3	3
Flight:	N										
	C		2	5	2	4	6	4	6	8	9
Resistance:	N										
	C		1				1				
Fighting:	N		1				2				
	C										
Grooming:	N			1–285	1–280	4–75	1–110	1–420			
	C	4–120	2–20						3–340	1–30	1–15
Play:	N										
	C										
Activity:	N	225	215	60	175	80	290	40	40	160	225
	C	205	255	60	140	20	260	15	40	120	140

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TABLE 10
RAW DATA FOR PAIRING OF NAOMI AND WHITEY—ALTERNATING DOMINANCE
(Whitey probably dominant)

		1	2	3	4	5	6	7	8	9	10
Feeding:	N						7	2	10	8	8
	W						3	8		2	2
Presentation:	N	5	5	1	1	3	3		1	2	1
	W										
D. V.:	N										
	W	2						2		1	2
Attempt:	N										
	W	1			1			1			1
Bullying:	N										
	W						1	1			
Cringing:	N										1
	W					1					
Passivity:	N							1		1	2
	W										
Flight:	N						1	2		1	3
	W		1								
Resistance:	N										
	W										
Fighting:	N	1									
	W										
Grooming:	N				1–40			3–410	3–235	2–395	3–300
	W				1–10			1–20		2–20	2–25
Play:	N					1–410	1–10				
	W										
Activity:	N	80	440	155	495	45	290	65		25	95
	W	40	70	75	170		60	30	10	25	40

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TABLE 11
RAW DATA FOR PAIRING OF RED AND KATHRYN—RED DOMINANT

		1	2	3	4	5	6	7	8	9	10
Feeding:	R						10	10	10	10	10
	K										
Presentation:	R										
	K	6		4	7	1	6	3	4	3	1
D. V.:	R										
	K										
Attempt:	R										
	K										
Bullying:	R	10	7	11	7	5	5	6	10	15	6
	K										
Cringing:	R										
	K			1				2		3	5
Passivity:	R										
	K			3	2		3	3	7	9	2
Flight:	R										
	K	12	6	7	4	5	6	8	6	6	6
Resistance:	R										
	K		3						1		
Fighting:	R										
	K										
Grooming:	R										
	K										
Play:	R										
	K										
Activity:	R	100	190	185	170	160	120	75	110	65	110
	K	330	520	380	360	455	465	290	165	175	265

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TABLE 12
RAW DATA FOR PAIRING OF RED AND CHRISTY—RED DOMINANT

		1	2	3	4	5	6	7	8	9	10
Feeding:	R						9	8	10	10	9
	C						1	2			1
Presentation:	R	1		1		2	2				
	C		1		1		1	2	1		1
D. V.:	R	13	11	12	11	9	7	4	2	6	7
	C	3		2	1	2	1	1			
Attempt:	R	1				2					1
	C		2	1	2		2	1		1	
Bullying:	R	1	2	1	3	3	1	3	1	1	1
	C										
Cringing:	R										
	C					3	1				1
Passivity:	R	2		2		1	1	1			
	C	13	12	11	11	7	7	4	3	7	6
Flight:	R										
	C	1	1		1	4	1	3		1	2
Resistance:	R	1			1						
	C	2				1					
Fighting:	R	1									
	C										
Grooming:	R			1–35	3–55	2–20					
	C	10–210	3–35	11–270	5–260	3–85	2–25	3–180	3–110	2–250	7–440
Play:	R										
	C										
Activity:	R	55	325	90	35	145	175	150	200	135	25
	C	25	260	25	25	60	80	75	135	120	

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TABLE 13
RAW DATA FOR PAIRING OF WHITEY AND KATHRYN—WHITEY DOMINANT

		1	2	3	4	5	6	7	8	9	10
Feeding:	W						10	9	10	10	10
	K							1			
Presentation:	W			1							
	K	5	4	2		1	3	2	2	1	
D. V.:	W	1	2				2				
	K										
Attempt:	W		2								
	K		2	1					1		
Bullying:	W		3	6	5	8	4	3	8	4	3
	K										
Cringing:	W										
	K							1	2	1	
Passivity:	W										
	K	2	4	4	5	6			2	1	2
Flight:	W										
	K			3	2	3	6	6	7	3	4
Resistance:	W										
	K					1	1			1	
Fighting:	W										
	K										
Grooming:	W	1–5	1–5	1–5	2–25	1–5	1–15	1–15			1–5
	K	2–290	4–285	2–135	1–45	1–95	2–40	1–90	2–195	1–15	1–170
Play:	W										
	K										1–10
Activity:	W	20	15		105	45	90	50		120	80
	K	130	160	255	395	310	220	275	205	465	315

only length of time in seconds is given. For instance, in this same table, in the fifth period, Blue groomed Red once for 270 seconds, and Red groomed once for only 15 seconds. The activity scores are very crude and unreliable. They can be considered significant only when there are large and consistent differences.

Table 14 is a summary of these raw data insofar as they have

TABLE 14
SUMMARY OF DATA IN TABLES TWO—THIRTEEN

	B	N	W	C	B	N	W	N	W	R	R	W
	R	K	C	K	W	R	R	C	N?	K	C	K
Feeding	259	163	199	52	60	54	33	49	15	50	46	49
	21	117	81	8	0	6	17	1	35	0	4	1
Presentation	0	0	1	3	0	13	0	3	0	0	6	1
	4	15	19	22	2	0	10	2	22	35	7	20
D. V.	46	28	27	9	41	15	29	23	7	0	82	5
	2	0	21	0	0	1	4	0	0	0	10	0
Attempt	1	5	17	0	14	11	4	4	4	0	4	2
	7	0	1	0	1	0	3	1	0	0	9	4
Bullying	41	83	1	30	81	33	2	54	2	82	17	44
	0	0	0	1	0	0	0	0	0	0	0	0
Cringing	0	0	0	0	0	0	0	0	1	0	0	0
	0	0	2	0	44	8	0	26	1	11	5	4
Passivity	1	8	21	0	0	0	3	0	0	0	7	0
	62	32	33	21	34	16	28	17	4	29	81	26
Flight	0	0	0	0	0	0	0	0	1	0	0	0
	23	23	5	27	74	42	3	46	7	66	14	34
Resistance	0	0	0	0	0	0	0	0	0	0	2	0
	1	3	2	5	14	8	0	2	0	4	3	3
Fighting	0	1	1	6	3	17	0	3	0	0	1	0
	0	0	0	1	0	0	0	0	1	0	0	0
					V.V. —1							

significance for dominance. Thus the scores for grooming, play, and activity are not included in this table. In this table the name of the dominant animal is always placed above that of the subordinate animal. The same is true for the scores.

It will be seen that in 11 of the 12 pairings, dominance was unmistakable and consistent. In the Whitey-Naomi pairing, dominance changed and was unstable. We shall accordingly omit the data

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TABLE 15

TOTALS AND PERCENTAGES FOR ELEVEN DOMINANT AND ELEVEN SUBORDINATE ANIMALS

	Eleven dominant animals		Eleven subordinate animals	
	Totals	Percentage	Totals	Percentage
Food	1014	80	256	20
Presentation	27	17	136	83
D.V.	305	89	38	11
Attempts	62	70	26	30
Bullying	468	99.9	1	0.1
Cringing	0	0	100	100
Passivity	40	10	379	90
Flight	0	0	357	100
Resistance	2	4	45	96
Initiation of fighting	32	97	1	3

for this pairing from further discussion. With this pairing omitted, Table 15 is a final summing up of the data in the previous table. The data for the 11 dominant animals are lumped and compared with the data for the 11 subordinate animals.

A comparison of this table with Table 16 of the second paper in this series (5) will be instructive. Percentages for the dominant animals in that group and the same percentages for the dominant animals in the present experiment are given in Table 16.

It will be seen that the quality of the behavior syndromes characteristic of the dominant animal and of the subordinate animal remains about the same, even though fairly wide percentage differences for various details of the syndromes are observable in the comparison. These differences are really very small if we consider the many

TABLE 16

LUMPED DATA PERCENTAGES FOR ALL DOMINANT ANIMALS COMPARED WITH SIMILAR DATA OF PREVIOUS EXPERIMENT

	Previous experiment Ten dominant animals Percentage	Present experiment Eleven dominant animals Percentage
Food getting	97	80
Presentation	43	27
D-V mounting	98	89
Bullying	99	99.9
Cringing	0	0
Passivity under aggression	1	10
Flight	1	0
Initiation of fighting	85	97

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variable factors that are impossible to control, e.g., differences in hunger drive, differences in grooming drive, differences in adaptation to the experimental situation, etc. We are inclined to consider the data obtained in the first experiment more reliable than those obtained in the present experiment since only six animals were used in various pairings in the latter. Any uncontrolled attenuating variable present in one animal would have a much larger effect on the final group score if this one animal were used in four pairings instead of being used in only one.

It is all the more remarkable that the percentage scores for mounting, bullying, cringing, and flight are so similar in the two experiments. These are apparently the best and most reliable indicators of dominance and subordination.

Grooming. The results for grooming definitely indicate that, even if grooming were to some extent determined or influenced by dominance status, this connection is so tenuous, or so intermingled with other determining factors which work in other directions, that nothing can as yet be said about it. In our previous study we found that the dominant animal groomed more often than he was groomed (62 per cent of all plus scores). In the present experiment the data are almost exactly reversed. We find that the subordinate animals gets 66 per cent of all plus scores for grooming.[3] We are compelled in the light of these data to withdraw the tentative suggestion we made in that paper that there might be a correlation of grooming behavior with dominance status. Our conclusions as to the extent of altruism in this behavior in the macaque, however, are *not* affected by these results.

Establishment of a Hierarchy. Were it not for the reversals of dominance in the Whitey-Naomi pairing, the hierarchy would be perfect. In any case this means no more than a possible reversal of two neighboring positions in the hierarchy. Since Whitey was more dominant by mere inspection and also since he scored *more* dominant in the more crucial scores mentioned above, we shall consider him to have been the dominant animal in this pairing at least for the purpose of constructing the hierarchy.

The hierarchy then from most dominant to least dominant would be (1) Blue, (2) Whitey, (3) Naomi, (4) Red, (5) Christy, and

[3]The calculations are not included here in order to save space. They may be easily derived from the tables, however.

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(6) Kathryn. There were no exceptions to this order. Each animal was dominant to every animal below him in the scale in all the separate pairings.

Size and Dominance. A comparison with Table 1 will show that there is at least a general trend for the largest animal to be the most dominant. If the correlation were perfect, Whitey should have been more clearly dominant over Naomi than he was. Red and Naomi weighed about the same, but Naomi was clearly dominant over Red. Generally these data substantiate the conclusion previously arrived at (1), that large difference in size usually insures dominance to the larger animal but small superiority in size may be outweighed by social attitudes of cockiness, confidence, and aggressiveness.

The Effect of Starvation on Dominance. The last three experimental periods of the first set of interpairings were under conditions of relative starvation. It will be seen that the general effect was one of heightening and sharpening of dominance. The overlord in every case behaved in a typically dominant fashion whether or not he had previously done so. A better way of describing what happened is to say that if there had been any lapses in the dominance behavior syndrome of the overlord, there were none in these three periods. Under conditions of starvation the dominance behavior syndrome emerges clearly and with less lapses and less tolerance. Of course it would then be expected that if the overlord had been behaving in such a fashion under ordinary conditions, starvation would make no difference in his behavior. A starvation technique would then appear to be on theoretical grounds the best way of determining the true overlord in a pair of animals which had vacillated and changed. In retrospect this would indicate that, in the Whitey-Naomi pairing, the doubtful status of their dominance rôles could have been resolved by such a technique. The theoretical and practical implications of these scanty data indicate the probable fruitfulness of a careful and complete research on the question.

Behavior in the Group. Full descriptive notes were taken in longhand by the experimenter who sat in front of the cage in full view. It was his impression that his presence disturbed the animals for a few minutes and then was neglected so long as he made no sudden moves. When it was necessary to get up to feed them or for some other reason, the animals were markedly disturbed for a moment. Since this happened infrequently, it was probably of little

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importance except during feeding. The influence of the writer's presence on feeding behavior and general social adjustment is described in the following notes. These notes are not given completely because of lack of space. What is presented is taken verbatim from the notes.

OBSERVATIONS ON GROUP BEHAVIOR

Wednesday, August 28th

4:30 P.M. Fed at 12 M. Two least dominant animals (K and C) put in together. C dominant to K in previous pairing; no attention to each other except tended to huddle; frightened by new cage; no dominance behavior. K more active; no fear of each other. After about 3 minutes K started to groom C, who jumped, and K cringed while C stared (dominance stare) ..... K very active as usual; C sits quietly on shelf. After little grooming by C, he comes to floor for first time. K pulls C's chain with hind feet and leads him along 5 seconds (scored as bullying); no protest by C. Both up to shelf; he makes several attempts to mount but no room, and she is too active. Finally he mounts fully with K passive. Same again—achieved by C presenting to K. She comes up, he turns quickly and mounts—no entrance, no erection, followed by grooming. ..... They stay together all the time with K more confident and active in new surroundings. She starts to play by pulling his chain and he attacks her vigorously. She runs ..... D.V. by C; K passive; momentary, no reaction, few movements. ..... He attacks her suddenly for no reason and she walks away. He is becoming more active and confident.

5:15 P.M. Next dominant animal brought in (Red)—dominant to both animals in previous pairings. R frightened; K comes over and presents; then C comes over and presents. R does nothing. C starts to groom and maneuvers round to mount. R snarles and bites C who at once presents and tries no more. C bullies and seizes K, who runs. C presents as R approaches. C becomes much more pugnacious with respect to K since R has been brought in, much dominance staring and snarling. She stays away from him now where before they were together. Now C stays with R, allying himself with the stronger one; grooms R for the 70 seconds. K climbs up to shelf where other two animals sit. C snarls at her and R does too: a few seconds later they keep on threatening K who flees often. C presents to R (full) and grooms again. Again K comes close and C and then R threaten her. ..... Again C

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drives K off shelf; C's threats at her are of bluffing type—running starts and stopping short, opening mouth, jumping up and down, jerky up-and-down head movements, no overt attack, however. Little or none of this behavior occurred before R was brought in. R joins bullying when C starts. Much unprovoked bullying of K by both. . . . In spite of continuous bullying and threatening, K continues to attempt to join the other pair. She is continually driven off, usually by C.

Thursday, August 29th

4:15 P.M. All 3 on shelf; K alone; C and R huddled; no activity. Fed them bits of bread through wire screen; 1st feeding since 12 yesterday. I had to come close, and all were scared, K least so. K has always shown less fear of humans, even in previous pairings. In spite of the fact that K was closest to me, R got the first piece of food, even took one away from K when she got it. However, she tried hard in spite of R's bullying. When he got one mouthful, C and K got some food in spite of fact that R seemed to be trying just as hard. Later R drove K up to shelf; other two on floor in front of me, waiting for food. . . . R got 11 bits of food before C got 1; then 10 more for R before C got 1. C ate crumbs on floor during all this time; K still far away, vocalizing.

4:45 P.M. Next dominant animal brought in (Naomi)—dominant to all three in previous pairings. K huddled up to her at once in ventro-ventral embrace and groomed her. Then N attacked her very viciously. K almost frantic in her howling. During this mix-up, R kept on bullying N with her passive. They fought until he drove N off shelf and she compensated by threatening K. R was bullying C a bit. Then N started bullying K at a distance and looking at R. He got down off shelf and mounted her four times. N continued very angry at K—D.V. again by R, N passive. After it, N threatened K and made fuss. R mounted N and while R attacked C, N mounted R for long D.V. C, who came close, was viciously attacked by R and N kept on mounting him (R) all the time. Finally N and R huddled and N groomed; K in one corner, C in another. Thus two most dominant animals of the four have formed an alliance. R mounts N who was passive, and then grooms her. Same again. Full presentation of sexual type by N at all times—sloping back, exposed pelvis, tail high, etc.; she is in heat—red sexual skin, oedematous swelling of sexual skin and upper legs and base of tail, red nipples, pouchy face, etc.

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Now R's mounting of N becomes practically continuous; occurs again and again, interspersed with grooming by R. C and K all this time cringing in separate corners; C particularly badly frightened ..... Same has continued for about 15 minutes; R mounting N continuously, interspersing this with grooming. C and K scattered and cringing. R often threatens others while mounting. ..... As I approached to feed the animals, R rushed down from shelf and chased them all violently even before I dropped any food in. The while I was handing it in, N mounted R, repeated this four times. While I fed him, he was all alone. N mounted him once in a while; other two scattered; R got 1st 15 pieces, then K got one. Neither C nor N got one, possibly because N taking advantage of situation to mount R, and C completely cowed. When food stopped, R turned around and mounted N twice, and then she groomed him for a long time. Dropped food in, now through different spot—again immediately R comes for food; later N mounts him and then grooms him.

Put whole bread in slices in cage—K hungriest and boldest of all as always. This time came to get it from me. Others hung back waiting for me to leave before coming for food.

Went away for five minutes. When I came back, found amazing change. K was now viciously chasing C all around cage. He was in mortal terror. She caught him and bit him and tore at him until he went into cataleptic state. Other two animals came down and joined in. They were as vicious. The three of them practically ripped his ears apart—all bloody. They left, and K kept on doing this alone. Finally she stopped and settled down to bite him. Everytime R or N growled, threatened or even looked at K, she started turning and biting and bullying C. C finally lay in exhausted state, ears bloody, eyes half closed, in waxy flexibility. Other three kept on eating bread with N and R growling at K occasionally. *Without exception* any growl at her set her after C who ate absolutely nothing all this time and stayed on shelf in dazed state for all the time. Have never seen as vicious bullying as K's—who, in any case, had never showed any bullying at all during the whole course of the experiment with any single animal. Same state of affairs for 15 minutes. As I left N mounted K twice.

This change in dominance apparently caused by K getting food because more bold, hungry and active and less afraid of me. She probably then turned on C who was being afaid, but of me, not of her.

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Friday, August 30th

5:30 P.M. I find C very, very badly bitten; scars all over his face; nose, lips, ears, etc., bloody and torn; completely cowed, in spite of fact that in pairing he was completely dominant over K, and that he had at the beginning of this group experiment tried to mount R. C is being left alone now; however, K huddles up to him amiably enough. C sits (not cringing) vocalizes freely and even moves a bit in a quiet way. Other two scattered and prowling around the cage exploring; no attention to each other during this period. K chased by R once in a while and then huddles up to C; seems friendly. R most cocky and confident of group; quite certain of himself. K most active but watches N and R carefully. Long period of sitting about, apparently paying no attention to each other. Great change from yesterday. Must be pretty hungry and thirsty; not fed for 24 hours. Much vocalizing from R. K huddles to C again. C shows no fright, although once before did when K ran over instead of walking over—retracted lips and chattered fearfully. Now for period R up on shelf alone; K huddles to N. Suddenly R gets up, pulls K down from shelf by her chain. K huddles to C; N and R tend to form group just as K and C tend to form a group. All very calm and quiet.

At *6 o'clock* began dropping bits of bread through the mesh. Food gotten in following order: R 2, N 5, R 1, N 8, R 25. When 8th bit of food was dropped R pokes K, and drives her away. When the 10th bit of food was dropped, R again poked K who was persistent. K at once attacked C for first time today, very viciously. At 16th bit of food R really got very angry because N had been getting so much food; attacked her viciously, and all animals went away. R sits alone and gets all food thereafter.

Dropped whole sliced bread in; as usual I had to come very close to do this, and all the animals but K ran away. She sits here alone until I leave. Then they get food by coming up behind K and taking it from her. As soon as I bring the food C comes to corner, turns his back and cringes. Brought potatoes, water and apples. R paid no attention, remained at back of cage, but as soon as I brought apples, he rushed down in spite of me and got one apple. I put in a good deal of food so that C would get some. As there was plenty, they let him eat some; when I left all four were drinking and eating quietly except that, when any one approaches C, he runs away.

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Sunday, August 31st

4:30 P.M. Decide to starve animals for 48 hours—get effect on behavior. When came back, found that C had been taken out 24 hours ago by care-taker of laboratory in order to save his life. Apparently hunger caused some change of behavior—witness C's plight, also fact that K has scars on face. Must have been beaten. However no excitement or turmoil now. All three animals apparently very hungry, cry, vocalize continually. K on floor alone; R and N on shelf together. No behavior with respect to each other. N seems to be in heat still, judging from external anatomical signs but not from behavior.

4:45 P.M. Dropped bits of bread into cage, and strangely no response from any of the animals. Finally held up whole slice of bread. N got down and got 12 pieces in row; no attention to bits on floor. Then R came, ate bits on floor and ran back, not interfering with N. K definitely seemed impelled to come for food but was afraid to. Then dropped bits of food again—gotten by following animals in order: N 1 bit, R 4, N 2, R 15 in row. When the 6th bit of food was dropped, and N got it, R turned on N somewhat, not enough to make her run but just at that moment K dropped the water pan and the sudden noise made N run. R got all the food thereafter. At the far end N picked up a bit of food from the floor. R turned and chased her away. She ran very rapidly. Then R bullied K who showed great fear, cringing, and presented. Same thing, three times. 14 more bits of food. N got all while R bullied K continuously (must there always be a scape-goat in every group? K has taken C's place). Ten more for N while R is still busy bullying K. R mounts K once. Then 15 bits in row for R. N sitting by and not moving. When R goes away, then N gets food. R mounts K again. R gets 7 bits of food and deliberately goes up to bully K. R gets 14 more bits, dropping each one as he takes it without eating it, until he is really sitting in bread; but N never touches any of it. K has been far away ever since food was brought; her back turned on the whole procedure. She is almost as cowed as C was. Five more bits for N until R comes over from bullying K. As soon as R leaves for food, N stops trying until he goes away again. Just noticed K's chain caught in mesh—no wonder she could not run away. As soon as I release her, she makes a wild dash for the bread right through N who attacks her viciously (K doesn't care). She takes the bit and gorges herself, grunting all the while. Lot of excitement during all this

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with R mounting N four times as N bullies K. Finally all settled down to eat. K growls at animals in neighboring cage, and R bullies, mounting N again. K continues gorging. As R approaches, K goes back to him and makes full presentation. He half mounts but does not completely, and K goes back to gorging herself. Finally so do N and R; suddenly K runs away for no detectable reason. I put in a good deal of food and they continue eating, paying no attention to each other.

Monday, September 1st

11 o'clock. All three on shelf. Surplus food lying around on floor. R and N together; K alone. No fighting or aggression; no social behavior. K apparently not overtly afraid of either animal.

11:10 A. M. Next dominant animal, W, brought in. Other three up on shelf, looking at him; W on floor. R comes down, then N and K. R mounts W three times times (in spite of fact that W was completely dominant to him in pairing). Then W turns on R and gives him a good beating. All 3 animals gang up on W, but he remains confident and aggressive; ganging continuous; K gets awfully aggressive. He beats them again and again, but they remain aggressive, especially K who comes down to floor to snarl in W's face while other two growl from shelf. The three animals on shelf with W continually sitting on floor. K grooms R and R grooms N, then both groom N for sometime. W's presence seems to make a group of the other three animals. W has lost none of his confidence.

At *11:15,* N comes down deliberately and presents to W—full and prolonged—grooming each other for a while. K grooms R up on shelf; N stays close to W and presents for grooming very frequently. N gets around slowly into semi-d.v. position for moment; then presents a few times; again mounts him in semi-d.v. position—no movements. Very cautiously K comes down after grooming R for long time and grooms N. All four animals go indoors where I cannot observe them, and a fight ensues. K comes out bitten, but then all three gang up on W again. They get all excited, but he remains calm. They pull him down and really beat him for a while. K awfully beaten, but she seems to take it without any dampening of her aggression. She keeps starting the fights. Finally N and K get W in bad position, biting him badly, and he begins to give fright-pain cries and to turn his back. Now N and K bite him viciously while R mounts K. W runs away with K after him (first flight by W). K is still most aggressive. Finally W

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cringes in corner while she bites him, and R in the excitement keeps on mounting N and K. K bullies W tirelessly; W bleeding.

11:30. Finally W sits on floor panting, and other three sit quietly on shelf. Then they come down to floor. K starts walking over to W and he cringes and backs up. N comes over and starts bullying while R mounts her. W runs away. Then K and R join N in chasing and bullying; then quiet for sometime; 3 animals on shelf and W perched fearfully in farthest and highest corner of cage. Food dropped in; gotten in following order: R, K, K; R, K, K; R, K, K; R, R, R; R, R, R. K most bold about coming for food; R holds back. K least afraid of my presence and closeness. However, no great dominance behavior in this situation. Then K and N attack W and R joins viciously. W screams with pain. K most vicious and persistent. W absolutely beaten; no fight in him any more; his sphincters relax; finally he just goes into cataleptic rigidity in a ball in a corner and stays like that even when no one near. We may have to take him out to save him. R mounts N and K several times. Leave at *11:45.*

At noon W had to be taken out to save his life. That evening at *7 P.M.,* I did the following experiment: W, who has been recuperating all day in his own cage, and K who has remained in the outside cage with a group, are brought together up to the experimental chamber for pairing. As in the previous experiment, W dominant; K behaving subordinately from the very first moment that they were put together. This in spite of the fact that only that morning W had to be saved from K's aggression.

Behavior in trio in cage as before. N+R=group, and K is alone.

IV. Discussion

Comments on Group Observations. It is obvious that the behavior of these animals in groups could not have been predicted from the data obtained in the interpairings. The behavior of a group of three animals is something more than the mere addition of their separately taken reactions to each other. In other words the group of three is qualitatively different from a group of two animals, and a group of four is different in the same way from a group of three animals. While the data presented in the notes are very far from being final or definitive, they are yet important and suggestive

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enough to merit careful consideration. This is especially so because many separate researches are suggested by various parts of the data.

Behavior in the first group (of two animals) did not differ materially from their behavior in their previous experimental pairing. The introduction of a third animal (who had dominated them separately) introduced new behavior that seemed to be a function of the size of the group. Several general statements may be made as suggested descriptions in general terms of this new behavior. It may be that these overlap each other. They are to be considered as provocative rather than final, since the animals involved are too few for final statements. (1) Punishment is handed down. When the overlord asserts dominance over his immediate inferior in any way, this latter animal is impelled to assert dominance over *his* inferior by bullying, mounting, etc. (2) The middle animal (C) is made more pugnacious generally with respect to the subordinate animal (K) by the introduction of an overlord (R), even though he (C) was not very pugnacious when alone with K. (3) The middle animal seems to tend to ally himself with the overlord, and seems to prefer his company to that of his inferior. They tend to form a contact group and act to some extent as a unit. (4) The middle animal, rather than the overlord, tends to initiate the bullying of and fighting with the subordinate animal, even though the overlord may join in. (5) If one animal attacks another, the outsider will join with the attacker rather than with the attacked animal. (6) All these considerations seem to justify calling the subordinate animal the "scapegoat animal."

The anomalous middle position thus takes on a certain character of its own. While we should not anthropomorphize about the motivation of his behavior, we can at least point out that the net result of all these activities is (1) to protect the middle animal from the aggression of the overlord, and (2) to allow him to keep the highest possible dominance status.

The introduction of the next more dominant animal brought about behavior that is difficult to interpret, since she was in heat, and consequently the dominance drive assumed in her a less important rôle than might otherwise have been the case. Her presence, however, brought to light new behavior that is worthy of tentative generalization. An animal behaving in a concentrated fashion with respect to animal X seems to become an easier mark for the dominance display

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of animal Y. Several examples of this behavior are recorded in the observations, e.g., N bullying K was simultaneously bullied by R.

The new types of behavior observed in the three groups are also observed with some modifications in the four group, e.g., when R dominates N, she "hands it down" to K; two most dominant animals form a contact group; all the animals are more pugnacious than they were before.

K's behavior generally was very different from her behavior in the interpairings. In the records for these interpairings, many notes were made of her strong dominance drive. She never had a real opportunity to express it effectively until she became part of a larger group. Here she was aided by the apparent tendency noted above of animals on the sideline to come to the aid of an attacker rather than to the aid of the attacked animal. Obviously this gives a weak but pugnacious animal far more power than she could possibly wield in a group of two animals, and would indicate that absolute strength of dominance is more readily seen in a larger than in a smaller group. As soon as K made the first attack on C, the other two animals came to her aid and not to the aid of C. Once the break was made, and C became subordinate to the group of three animals, he also became subordinate to any *one* of the three. K thereafter adhered admirably to the "principle" of handing down punishment. It is interesting to note that, because K continued to be rejected by R and N, she formed a contact group with C and huddled with him amicably at all times except when she was handing down punishment.

When C was taken out to save his life, the behavior of the resultant three group slipped back to the behavior of the previous three group.

When W was brought into the group, he seemed to suffer under at least one disadvantage, in spite of the fact that he had dominated all of the animals in the group taken separately. They now seemed to consider themselves an "in-group" and him an outsider. His mere presence at once caused them to coalesce into something of a unit. Also they were adapted to the experimental situation and he was not, which gave them another advantage. K again led the attack (in the attempt to become what we have called the "middle animal"?). Again R and N came to the aid of K, who attacked W, rather than to the aid of W, who was attacked. W was whipped and eventually had to be removed to save his life. This left a three group, which acted generally as already described.

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It should be noted in C and in W that, when they lost dominance, they lost it suddenly and completely, seeming, in a moment, to give up dominance and accept subordination.

About five hours after Whitey had been removed from the group cage, advantage was taken of the opportunity to determine the possibility of a continuing trauma in this animal as the result of his very harrowing group experience. Also the experimenter was very curious about the question as to whether the dominance status in a pairing was the result of direct reaction to the elements inherent in the situation, or whether it was more largely the result of previous experience and social conditioning. Is an animal who has been subordinate in a previous pairing more likely to be subordinate in a new pairing?

Whitey and Kathryn were again paired in the experimental chamber in exactly the same way that they had been paired prior to the group experiment. It will be remembered that Whitey had been dominant over Kathryn in these pairings (see Table 13), and also that Kathryn was the leader of the group attack on Whitey which finally broke his spirit. She bullied him persistently and almost killed him single-handed.

In this pairing which lasted for ten minutes, Whitey was dominant, but not because he asserted or took dominance. He was dominant because of Kathryn's complete concession of this status to him. At the very first moment that they were put together, Whitey got into the corner and cringed for ten seconds while Kathryn ran about actively. Then they both ran about for 35 seconds. Then K spontaneously came over to W and presented to him of her own accord for fifteen seconds. He responded by genital inspection and then began grooming her. The rest of the ten minutes were spent in sitting about quietly and grooming by W. W got seven of the ten bits of food with practically no opposition from K. When K got the food bits, it was because of lack of opposition by W.

The dominance was obviously unmarked and given rather than taken. The indication would be then that Whitey was somewhat affected by his previous group experience, but also that Kathryn was again responding to present factors in the situation, e.g., Whitey's superior size. Her previous attitude of dominance in the group situation did not hang over into the present situation, although it was obvious that if she had made any attempt at all to achieve dominance status, Whitey would have been quite ready to accede.

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This result would indicate that the technique we used is worthy of further investigation and use.

The Establishment of a Hierarchy. Little comment need be made on the clear-cut data we have presented, except that perhaps they should be held suspect just because they are so unexpectedly neat. They indicate that our group was not nearly as evenly matched as we had supposed. The differences in weight should have been less than they actually were, since of course we now know that it is very easy to insure in advance a perfect hierarchy by selecting as subjects animals that differ substantially in their body weights. Our animals ranged from 5 lbs., 4 oz. to 8 lbs., 15 oz., or from 2352 grams to 4004 grams. Murchison's six roosters ranged from 3420 grams to 4000 grams (9). Our data are, then, not strictly comparable. Had our animals been as closely matched for weight as Murchison's, we might have got the same circularities of dominance status that he obtained.

Attenuating Factors in the Intercorrelations of Dominance Behaviors. We have already pointed out in previous papers (2, 5) that our putative dominance attitude is not the only determiner of specific aspects of the dominance syndrome. Feeding behavior is of course also influenced by strength of hunger drive, by differential appetite for the particular food being used as a test goal object, by differences in speed of reactivity, etc. Sexual behavior is also partially determined by stage of the female's sexual cycle, by general differences in strength of sex drive, and by previous experience. In the present experiment, several more such factors came to light and may now be listed. (1) Fear of the experimenter was a variable quantity from animal to animal, some being much tamer and bolder than others. Kathryn, who was not at all bothered by the presence of the experimenter, won thereby an advantage over the others, particularly in the group experiment. (2) Differences in absolute strength of dominance proved to be very important. It is possible to rate (roughly) any animal on an absolute scale of dominance. One animal may obviously have a very strong drive to dominance that will manifest itself in any social situation whatsoever, even when he is in a subordinate position due to inferior weight and size. Other animals may be *given* dominance status because they are so much larger than their partners. The general distinction between dominance relative to one other individual and relative to the total

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of other individuals is important also in avoiding confusion in other contexts. (3) The factor of previous dominance or subordination experience does apparently have some effect on present behavior. (4) Starvation may effect differentially the dominance-subordination behavior of a pair of animals. Our exploratory experiment indicates that the dominant animal's behavior is sharpened and heightened, which in turn inhibits all the more strongly whatever dominance behavior the subordinate animal may have shown prior to starvation. (5) Priority on the spot seems also to have been an influential variable in our group experiment. The animals already in the cage have an advantage over newly introduced animals in the struggle for dominance, both because of alliances already formed and because of better adaptation to the strange situation. (6) Difference in drive to groom or to be groomed may be influential in partially determining the particular form that dominance behavior will take.

These are, of course, no more than a few of the factors that must inevitably tend to attenuate any correlation between various parts of the dominance behavior syndrome. They are sufficient, however, to indicate the complexity of such a task and also to induce a proper respect for the very high correlations actually obtained *in spite of* all these attenuating influences.

V. Summary and Conclusions

In a group of six rhesus macaques, every animal was paired with every animal by the technique described in a previous paper. The behavior syndromes characteristic of dominant and subordinate animals determined in a previous experiment were generally confirmed except for grooming behavior, which was judged not to be correlated with dominance status because of the discrepancy of data in the two experiments. No adequate data on play behavior were obtained and no conclusions were drawn therefore. Mounting and bullying proved to be the most reliable measures of dominance, and cringing and flight were found to be the most reliable measures of subordination.

The hierarchy of dominance constructed from the results of the separate pairings was found to be practically perfect in the sense that it showed no circularity of dominance relationships such as had been found in birds. This surprising result was adjudged to be probably a consequence of too great differences in weight of the animals in our group.

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An exploratory experiment on the effect of starvation seemed to indicate that the dominance of the overlord animal was heightened and sharpened by this treatment.

These animals, after the pairings were completed, were formed into larger groups whose conditions are described. It was found that new behavior emerged in these groups that was unpredictable from the data on pairings, since certain behavior is definitely a function of the size of the group. A group of three animals is a different *kind* of a group (in a qualitative sense) from a group of two animals. Animals that had been dominant in the pairings were, in the group, beset by alliances of their subordinates and beaten severely. The animal that had been at the bottom of the dominance hierarchy in the pairings turned out to be the most vicious and aggressive of the animals in the groups of four animals. This same animal, when paired separately soon after with one animal that she had almost killed while in the group, turned out to be as subordinate to him as she had been in the original pairing.

Various attenuating factors are discussed.

Generally the various techniques used in this experiment are considered to have brought to light suggestive rather than conclusive results. Many problems and questions have been brought to light that seem to be worth further investigation.

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